

Ontario Geological Survey

Northern Ontario Engineering Geology Terrain Study 61

WHITE RIVER AREA

(NTS 42C/NW)

Districts of Algoma and Thunder Bay

Compliments of
by
ONTARIO
MINISTRY OF NORTHERN DEVELOPMENT
AND MINES
John P. Gartner and D.F. McQuay

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Map 5094 (coloured) - Northern Ontario Engineering Geology Terrain Study,
Data Base Map, White River (NTS 42C/NW). Scale 1:100 000.

Map 5098 (coloured) - Northern Ontario Engineering Geology Terrain Study,
Septic Systems Capability Map, White River (NTS 42C/NW). Scale
1:100 000.

**Northern Ontario
Engineering Geology Terrain Study 61**

WHITE RIVER AREA

(NTS 42C/NW)

Districts of Algoma and Thunder Bay

by

John F. Gartner¹ and D.F. McQuay²

1.0 INTRODUCTION:

This report contains an inventory of regional engineering terrain conditions in the White River area, Districts of Algoma and Thunder Bay. The area, which covers NTS block 42C/NW, lies between latitudes 48°30'N and 49°00'N and Longitudes 85°00'W and 86°00'W. This report forms part of a series of publications which provide similar terrain data for some 370 000 km² of northern Ontario.

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The purpose of the mapping is to provide a guide for engineering and resource planning functions at a level of detail consistent with a scale of 1:100 000. The terrain information is contained on the Data Base Map (OGS Map 5094, accompanying this report). The Septic Systems Capability Map (OGS Map 5098, accompanying this report) is a derived map which classifies the terrain of the White River area in terms of its suitability for installation of septic systems.

Interpretation of existing black and white aerial photographs, at scales of approximately 1:54 000, was the primary method of obtaining this terrain information. The interpretation was checked with published and unpublished literature which documented previous field visits and observations. During the summer of 1978, roads in the area were traversed and observed terrain conditions recorded as further verification of the office studies. Thus, the map represents a reconnaissance overview of the engineering conditions of the terrain.

An engineering terrain legend was developed to facilitate the mapping and to provide a common format for the entire map series. This legend is shown on the accompanying data base map. Further information on the mapping techniques, legend format, and possible uses of the terrain data is available in the "Ontario Engineering Geology Terrain Study Users' Manual" (Gartner, Mollard, and Roed 1980), a companion publication to this series of maps and reports.

2.0 GEOLOGICAL SETTING:

2.1 BEDROCK:

The White River area is dominated by rugged bedrock terrain, the rocks being of Early Precambrian age. A large, irregularly shaped belt consisting of metasediments and lesser amounts of mafic to felsic metavolcanics lies between Hemlo on the western margin of the area and White Lake in the central part. The segmented appearance of this belt is caused by several intrusions of massive granodiorite and quartz monzonite. A second smaller metavolcanic-metasedimentary belt occurs in the vicinity of Dayohessarah Lake on the eastern margin of the area. The remainder of the area, by far the larger portion, is underlain by undifferentiated felsic igneous and metamorphic rocks. Middle to Late Precambrian diabase dikes, most trending northwest and a few trending northeast, cut all other rock types (Ayres *et al.* 1971; Milne *et al.* 1972).

The two metavolcanic-metasedimentary belts have medium mineral potential, particularly for base metals. The potential of the remainder of the area is rated as "least" or "unknown" (Springer 1977).

2.2 QUATERNARY:

The Laurentide ice sheet advanced from the northeast and deposited a thin, discontinuous veneer of ground moraine over the bedrock surface. This till is generally less than 1 m thick, but can thicken to more than 5 m on the flanks of some of the bedrock hills. Glaciofluvial outwash deposits form planar features in many lower parts of the map-area. One such outwash deposit, extending northeast from White Lake is quite extensive in area. A number of esker ridges trend in a generally south-southwesterly direction. Both the eskers and the outwash deposits were formed during deglaciation of the area in late Pleistocene time.

The map-area was also inundated by glacial lakes. Glaciolacustrine deposits consisting of silt, clay, and sand occupy some of the river valleys, such as that of the Black River in the northwest corner of the area. Other lake plain deposits are found scattered throughout the northern portion of the area. These glaciolacustrine sediments were likely deposited during the Post-Minong phase of Lake Superior between 9 000 and 9 400 years ago (Boissonneau 1966).

3.0 ENGINEERING TERRAIN UNITS:

3.1 BEDROCK:

3.1.1 Description:

Bedrock knobs (RN) are the dominant landform in the White River area. Bedrock outcrops are abundant, and overburden consists of a discontinuous layer of glacial till that is usually less than 1 m thick. However, on the sides of some of the bedrock hills, and in the low areas between these hills, the overburden can reach thicknesses of 5 to 10 m.

The till has a silty sand texture and contains a high percentage of stones, cobbles, and boulders. In fact, boulders are present over much of the ground surface. A sample of till, taken from a highway cut within the

bedrock knob unit east of White River, consisted of 78% sand, 19% silt, and 3% clay. This composition represents the typical matrix of till in this area.

Swamps are commonly found in low, stagnant areas between bedrock hills. These organic deposits form a subordinate landform in the predominantly bedrock knob terrain.

The topography is typically rugged, with relief often exceeding 60 m and slopes of bedrock hills being steep and complex. Relief appears to be higher in the eastern half of the map-area and modified to some extent in the western half. Drainage conditions in this rock terrain are usually dry, with the exception of small areas of organic terrain where conditions are generally wet.

A typical symbol depicting this terrain unit is:

$$\frac{RN(tMG,pOT)}{Hnj-D}$$

This indicates that bedrock is the significant landform from an engineering viewpoint, although there are associated deposits of ground moraine and organic material.

3.1.2 Significance:

RESOURCES: Portions of the rock can be used for crushed stone purposes, but detailed evaluations of suitability for aggregate use would be required. Ground water resources within the rock will be limited to fractures, faults, and fissures. The occurrence of aquifers is unpredictable and the terrain has only poor potential for ground water supplies.

GENERAL CONSTRUCTION: The major constraints in terms of construction are the presence of irregular and complex bedrock outcrops and large boulders on the ground surface. This means that below-ground excavations will require blasting. Site-grading will be expensive and rock fills will be necessary in grading works. Foundation conditions should be excellent on the bedrock, but route alignments will require rock cut-and-fill operations.

Because of the shallow drift cover and complex bedrock slopes, development activities are generally more difficult, and hence more expensive, than in areas of thicker overburden. Management of the land for any development would be complex. The variable and steep rock slopes, combined with the shallow overburden, will make the terrain sensitive to surface erosion, especially when cleared of vegetation.

WASTE DISPOSAL: The bedrock terrain is not amenable, in its natural state, to the disposal of waste, whether it be garbage, septic tank effluent, or industrial liquid waste. Development of lagoons or tile fields would require extensive grading of rock materials and importation of suitable soil fill. Fractures in the bedrock could act as conduits for migration of effluents, and the impact on surface drainage courses could be significant.

3.2 MORAINAL LANDFORMS:

3.2.1 Description:

Ground moraine (MG) occurs either as a subordinate unit in conjunction with the rock knob terrain, as previously discussed, or as a dominant unit in the form of a thicker veneer over the bedrock. The latter situation is represented by the green colour on the Data Base Map (OGS Map 5094, accompanying this report). Areas where ground moraine is the dominant landform are scarce in the White River area.

Where the moraine is dominant, it forms a comparatively uniform mantle, up to 5 m in thickness, overlying the bedrock. The unit consists of stony, cobbly, and bouldery silty sand till. Much of this ground moraine has been inundated in the past by glacial lakes and meltwaters, producing a washed and modified surface throughout much of the area. Thus, it is possible to find thin layers of stratified sand, silt and, in some cases, gravel overlying and intermixed with the glacial till material.

A typical symbol depicting this terrain unit is:

$$\frac{tMG,sLP/R(RN,pOT)}{Lupw-D(M)}$$

This indicates that ground moraine is the dominant landform, but that glaciolacustrine sand deposits are common in some parts of the unit. Both the ground moraine and lake plain landforms generally occur as a thin mantle over bedrock. Rock knobs and organic terrain can be found as subordinate landforms. The terrain is of low relief, undulating, and planar, and has been reworked by glacial meltwaters. The surface drainage is predominantly dry, but there are some wet areas, especially in the organic terrain.

3.2.2 Significance:

RESOURCES: Sand and gravel resources are scarce within the morainal landforms. Small pockets of stratified sand and gravel may be found where glacial meltwaters and lake waters have reworked the till. A number of pits have been opened for local highway use in the ground moraine along Highways 17 and 614. However, quantities have been small and unpredictable and the material has usually been dirty and of low quality.

Ground water resources for water supply purposes are not expected to be significant. The ground moraine unit is generally too thin to provide good aquifer conditions.

GENERAL CONSTRUCTION: Because the glacial till is bouldery and often forms only a thin veneer over bedrock, there will be a number of construction problems, particularly in connection with rock excavation and grading. Excavations, except for very shallow ones, can be expected to intersect bedrock and zones of very bouldery soil. However, the till should be reusable as fill and foundation conditions should be adequate for normal structures.

WASTE DISPOSAL: The bouldery nature of the overburden and the existence of bedrock near the surface put constraints on the location of waste disposal facilities. The successful siting of lagoons and landfills will depend, to a great extent, on the thickness of till overlying the bedrock. Septic systems are likely feasible in many localities, but detailed investigations of local conditions are required in all cases.

3.3 GLACIOFLUVIAL LANDFORMS:

3.3.1 Description:

Outwash (GO) landforms, deposited by glacial meltwaters, underlie terrain of low relief in numerous locations throughout the map-area. The largest such deposits occur northeast of White Lake, through the central part of the area in Bryant, Flood, Johns and Odum Townships, and along many of the river channels in the southern part of the area.

The material in these outwash deposits varies from sand to sand and gravel. A sample, taken near Bouchard Lake in northeastern Bryant Township, consisted of 54% gravel, 45% sand, and 1% silt. The letters (sg) indicate gravelly sand which contains appreciable material suitable for crushing. Where only the letter (s) is used to describe the outwash material, it is expected to be somewhat finer, possibly in the fine to medium sand range. However, the landform still will have appreciable pockets of coarser gravelly material. Northeast of White Lake, the outwash apparently overlies glaciolacustrine lake plain sediments. Because of the inaccessibility of the terrain, this interpretation has not been verified by ground studies. Such studies should be undertaken prior to considering the deposit as a potential source of aggregate.

In all cases, the outwash deposits have undulating to planar, low relief topography. Kettle holes are present in some of the deposits.

The granular soils in these landforms have good internal drainage characteristics. Surface drainage is generally dry, but in some cases may be mixed wet and dry. Ground water tables can be close to surface, as in the case of the deposit immediately north of the town of White River.

Examples of terrain unit symbols are:

<u>sgGO(AP,RN,pOT)</u>	<u>sGO(AP,pOT)</u>	<u>sgGO/R(pAT,RN)</u>
Lpu-Mh	Lp-Dh	Lpu-M

These symbols illustrate the complexity of some of the units, but also emphasize the dominance of the outwash from an engineering viewpoint. Subordinate landforms are common and the user should be aware of their existence from an engineering viewpoint.

Eskers (GE, >>>>>>>>), which have been mapped in a number of localities within the area, occur as ridges that are generally less than 15 to 20 m in height. They trend in a south-southwesterly direction and in some cases are associated with outwash deposits.

The material in the eskers varies from gravelly sand to sand and gravel, thus making them good potential sources of mineral aggregate. However, because the landforms are not massive, they would only be capable of supplying local requirements.

Typical terrain unit symbols are:

$\frac{\text{sgGE/R(pOT,RN)}}{\text{Lun-M}}$

$\frac{\text{sgGE,sgGO/R(RN,pOT)}}{\text{Lupk-D(M)}}$

The first example indicates that the esker occurs as a mantle over bedrock. Organic terrain is common in low areas and rock knobs may protrude above the surface of the unit. Relief is low, topography is undulating and occasionally knobby, and drainage is mixed. In the second example, the esker consists of coarser materials, grading to gravelly sand, and is associated with a blanket of gravelly sand outwash deposited over the bedrock. Rock knobs and organic terrain can be expected as subordinate landforms within the unit. Relief is low, the terrain is undulating and planar, but there are some kettle holes. Drainage is dry, but can be mixed in the subordinate landforms.

3.3.2 Significance:

RESOURCES: Sand and gravel resources in the White River area are only of local importance and are contained mainly in glaciofluvial landforms. Of particular significance are the eskers scattered throughout the map-area and the outwash deposit situated in Johns and Odium Townships in the east-central part of the area. However, poor drainage conditions in the outwash deposits may limit their usefulness. Other deposits with crushing potential occur in Flood Township in the central part of the area and north of Shabotik Township on the northern margin of the area.

There is the potential for the existence of ground water supplies at depth in the deeper outwash deposits. Where the deposits occur as a thin mantle

over the bedrock, there is considerably less potential for ground water. In general, ground water potential can be rated as fair to good in these glaciofluvial landforms.

GENERAL CONSTRUCTION: The glaciofluvial landforms provide good construction conditions. The terrain is usually level to undulating, the materials are well drained and easy to handle in excavation and compaction, and bearing capacities are generally adequate for normal foundation loadings. However, many of the outwash deposits occur in flat, low-lying areas and have a potentially high ground water table. This situation can cause serious construction problems if it is not recognized early in the planning process.

WASTE DISPOSAL: The disposal of solid and liquid wastes must be approached with considerable caution because of (1) the permeable nature of these soils, (2) the possibility of connection between ground water and surface water, and (3) in some cases, the proximity of bedrock to the surface. Septic systems, if properly designed, should function satisfactorily. However, detailed hydrogeological investigations are recommended prior to construction of any waste disposal facility.

3.4 GLACIOLACUSTRINE LANDFORMS:

3.4.1 Description:

Glaciolacustrine plains (LP) are scattered throughout the northern half of the map-area, particularly along the valley of the Black River in the northwest corner and along the Shabotik River in the northeast corner. These deposits were laid down in glacial lakes contained within the Lake Superior Basin and also in local pondings during the final stages of deglaciation. Milne (1968) described the glaciolacustrine sediments along the Black River as varved silt and clay; varves generally range in thickness from less than $\frac{1}{4}$ inch to 1 inch, but in one exposure a 6-inch thick varve was observed. They are nearly always overlain by thick strata of bedded sand, which may grade down through fine sand, silt, and clay into varved clay. Some sections of varved clay are overlain by coarse sand beds interspersed with 1-foot thick pebble bands. Thomson (1932) referred to these sand plains and the high banks of sand and clay occurring along the Black River.

The stratigraphic sequence in these sediments generally consists of fine sand and silt overlying varved clay and silt. Boreholes drilled through some of the deposits for bridge foundations indicate about 30 m of glaciolacustrine sediments before bedrock or till is intersected. In many cases, the surface sand has been blown into dunes by wind action.

A sample, taken near the Black River in the northwest part of the map-area, contained 52% sand, 46% silt, and 2% clay. This sample is typical of the upper stratum of sand and silt which overlies the varved clay and silt.

Typical symbols depicting this complex terrain unit are:

$$\frac{\text{smcLP(ED,RN,pOT)}}{\text{Lup-D(M)}}$$

$$\frac{\text{smcLP/R(RN,AP)}}{\text{Lud-D}}$$

A *glaciolacustrine beach* (LB) occurs along Highway 614 in the northwest corner of the map-area. It is represented by the symbol:

$$\frac{\text{sgLB/tMG/R(RN,pOT)}}{\text{Lup-D(M)}}$$

This indicates that the beach has been deposited over a thin ground moraine till unit which overlies bedrock. Rock knobs and organic terrain are common subordinate landforms.

Milne (1968) described a 100-foot section in a gravel pit as consisting of well-bedded coarse sand and gravel and another section, containing a considerable amount of gravel, as being either a beach spit or a bar. A number of sand and gravel pits have been opened in this landform.

3.4.2 Significance:

RESOURCES: Except for the beach deposit, these glaciolacustrine sediments have little resource potential with respect to sand and gravel. Within the beach deposit, there is probably some remaining potential for sand and gravel materials, judging from the number of pits already developed.

Ground water resources are generally scarce within the silt and clay strata, but aquifers might occur at depth beneath the clay, especially if sand and gravel overlie the bedrock.

GENERAL CONSTRUCTION: Because the glaciolacustrine soils are basically fine grained, with high percentages of both silt and clay, construction conditions within the unit are far from ideal. The occurrence of sand deposits on surface mitigates these poor construction conditions to some extent, but the user should be aware of potential seepage zones at the contact between the sand and the underlying varved clay.

The variability and complexity of the stratigraphy also introduces a number of construction problems. The following conditions can be expected:

- 1) Slope instability where deep deposits of silt and clay are encountered along river banks or on man-made cuts;
- 2) Erosion and gullyng on exposed slopes, with resultant siltation of drainage courses;
- 3) Difficulties in earth movement operations and subsequent compaction of fill where silt and clay are the predominant materials and where surface drainage conditions are poor, especially during wet weather;
- 4) Low bearing strengths for footings and foundations where fine grained soils are deep; and
- 5) Frost susceptible soils which could affect pavement design and backfill operations.

WASTE DISPOSAL: Septic tile field designs must contend with impermeable soils and poor drainage conditions. These problems will be less severe in areas where adequate thicknesses of sand overlie the clay. Solid waste disposal facilities may lack suitable fill materials and care must be taken to protect surface waters from contamination. It would be necessary to investigate, in detail, the stratigraphic sequences and ground water regimes at depth. The disposal of liquid wastes in lagoons is possible, but construction could be complicated by the existence of surface sand and poorly drained silty soil.

3.5 ALLUVIAL PLAINS AND ORGANIC TERRAIN:

3.5.1 Description:

Alluvial plains (AP) border all drainage channels, but are only of significant size on the Black and White Rivers. The Black River alluvial plain shows many good examples of oxbows and meandering channels. The symbol describing the Black River flood plain is:

$$\frac{smAP(pOT)}{Lpc-M}$$

The materials are silty sand in texture and organic deposits are common. The topography is channelled and of low relief. Drainage is mixed and a high water table can be expected within the alluvial soils.

Organic terrain (OT), which is not particularly common in this area, generally occurs as a minor landform in the bedrock knob terrain. The only organic terrain of any size occurs in association with the outwash northeast of White Lake. Here, the symbol

$$\frac{pOT/sGO}{Lp-W}$$

indicates that the organic terrain forms a veneer over outwash deposits. The landform has wet surface drainage.

3.5.2 Significance:

These alluvial and organic landforms have poor engineering properties and should be avoided by human activities. They are prone to flooding, contain soft and compressible soils, and are generally unsuitable for any type of development.

4.0 SUMMARY OF ENGINEERING SIGNIFICANCE:

The preceding section described the characteristics of the major landform types and the engineering and resource significance of these units. Table 1 is a summary of the general engineering significance of the more common

TABLE 1 SUMMARY OF ENGINEERING SIGNIFICANCE

RESOURCE POTENTIAL	BEDROCK RN(tMG,pOT)	MORAINAL tMG/R	GLACIOFLUVIAL		GLACIOLACUSTRINE smclP(pOT,RN)	ALLUVIAL pAP(sgGO)	ORGANIC pOT	
			sGO(sgGE,RN)	sgGE/R				
LIGHT CONSTRUCTION	Sand & Gravel	Poor	Good	Good	Poor	Poor	N/A	
	Ground Water	Poor	Good	Fair	Poor to Fair	Poor to Fair	Poor	
	Excavation	Blasting	Fair	Good	Fair to Good	Fair	Poor	
	Foundation	Excellent	Good	Good	Good	Poor	Very Poor	
WASTE DISPOSAL SUITABILITY	Grading	Difficult	Fair	Good	Good	Poor to Fair	Poor	Very Poor
	Material Re-Use	Rock Fill	Good	Good	Good	Poor	Very Poor	Very Poor
	Septic Tanks	Very Poor	Fair	Good	Fair	Fair to Poor	Very Poor	Very Poor
	Landfills	Poor	Fair to Poor	Fair	Fair	Fair	Very Poor	Very Poor
	Lagoons	Very Poor	Poor to Fair	Fair to Poor	Poor	Fair	Very Poor	Very Poor

terrain units found in the area. This table is intended only as a guide to help the reader in assessing the overall significance of the map-units. Site-specific work is necessary to better define actual ground conditions. Also, it must be realized that there are a number of conditions, such as drainage and slope, which are not considered in the table but which may affect the engineering significance of the various terrain units.

5.0 EXAMPLE OF DERIVED MAP: SEPTIC SYSTEMS CAPABILITY:

5.1 GENERAL COMMENTS:

The Data Base Map (OGS Map 5094, accompanying this report) is readily adaptable to the preparation of various land capability maps which portray the suitability of the terrain for specific uses. To demonstrate this application, terrain units in the White River area have been classified in terms of their suitability for septic system operation. The results of this evaluation are shown on the Septic Systems Capability Map (OGS Map 5098, accompanying this report). Other possible types of derived maps are discussed in the "Ontario Engineering Geology Terrain Study Users' Manual" (Gartner, Mollard, and Roed 1980).

The intent of this type of evaluation is to provide guidance for regional planning purposes. The level of detail that can be expected is consistent with the 1:100 000 scale. Detailed soil and drainage studies should be undertaken to assess the suitability of specific sites.

5.2 CRITERIA:

Septic tile fields require certain soil, topographic, and drainage conditions to operate effectively. The basic physical site requirements are:

- 1) Soil depths of at least 1.5 m above the high water table or impermeable materials such as bedrock,
- 2) well-drained soils (e.g. silty sand) having adequate permeability for safe operation of the tile field, and
- 3) a level to gently sloping land surface.

5.3 LAND CAPABILITY UNITS:

To develop the Septic Systems Capability Map (OGS Map 5098, accompanying this report), the terrain unit symbols were interpreted in terms of the above criteria for septic systems. Areas with similar ground conditions were grouped into four classes of varying suitability for septic system installation.

- 5.3.1. UNIT 1:** Areas of level, well-drained, deep granular soils, shown in green on the Septic Systems Capability Map, should provide good conditions for construction and operation of septic tile fields. The glaciofluvial outwash deposits, some of which are located around Regan in the central part of the area, possess the most suitable conditions for siting of septic tile fields. Small areas of bedrock and organic terrain, unsuitable for septic system installation and depicted as the subordinate landforms on the Data Base Map (OGS Map 5094, accompanying this report), may be found within this unit. Detailed studies to determine soil permeability and possible effects on ground or surface waters would be necessary to properly assess specific sites.
- 5.3.2 UNIT 2:** Terrain conditions in areas shown in orange on the map will present some problems for siting of septic tile fields. Granular soils, though well drained, may either form too thin a layer over bedrock or have a high water table. The heavy clay soils of the glaciolacustrine deposits may be too impermeable to allow for adequate infiltration of effluents. Specially designed tile fields would be required in this type of terrain. In some instances of marginal site conditions, importation of a suitable soil fill or use of special tile field designs may alleviate the problems. Careful site selection in these areas will be important. However, the suitability of a specific site and the extent of corrective measures required can only be determined by a site-specific study.

5.3.3 UNIT 3: These areas, shown in pink on the map, include level, fine-textured soils that may have high water table conditions and areas containing equal proportions of mineral soil and organic materials. In areas of fine-textured soil, the constraining factors in the location of septic tile fields are drainage and low permeabilities. Where wet and dry ground conditions exist in relatively equal proportions, potential sites may be difficult to locate. High water tables and possible contamination of surface and ground water will be a concern. Careful site selection is important in these areas and, where applicable, corrective measures will probably be required. Site-specific studies will be required to properly assess the problems, so as to ensure that tile fields are properly located.

5.3.4 UNIT 4: Areas of organic terrain, alluvium, and bedrock terrain (shown in white on the map) pose severe problems for septic system construction and operation, and can be considered unsuitable. Very poor drainage, susceptibility to flooding, and organic or fine-grained surface materials preclude location of septic systems in organic or alluvial terrain. In bedrock terrain, the very thin soil cover and rugged topography are major constraints. However, small areas within the bedrock terrain might have suitable conditions for individual sites, but detailed investigation of local conditions would be required.

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Geotechnical Report Index File, Geocres No.

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42C-9	Black River Diversion
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Strip Map Index, Materials and Testing Division, Contract No.

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77-90	Highway 17

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**MAPS
NOT
FILMED**

**CARTES
OMISES**